

The landmark Americans with Disabilities Act (ADA), enacted on July 26, 1990, provides comprehensive civil rights protections to individuals with disabilities in the areas of employment (title I), State and local government services (title II), public accommodations and commercial facilities (title III), and telecommunications (title IV). Both the Department of Justice and the Department of Transportation, in adopting standards for new construction and alterations of places of public accommodation and commercial facilities covered by title III and public transportation facilities covered by title II of the ADA, have issued implementing rules that incorporate the **Americans with Disabilities Act Accessibility Guidelines (ADAAG)**, developed by the Access Board.

U.S. Architectural and Transportation Barriers Compliance Board

BULLETIN #2: VISUAL ALARMS

"The severity of hearing problems was strongly associated with age. Persons 65 and older constituted 69 percent of the population with the most severe hearing trouble...but only 8.7 percent of the population without hearing trouble."

*Digest of Data on Persons with Disabilities
(1984)*

Why are visual alarms required?

One American in a hundred has a severe hearing loss; nearly one in ten has a significant loss. Those who are deaf or hard-of-hearing--a growing percentage of our population, due largely to the growth in the numbers of older persons--depend upon visual cues to alert them to emergencies. A visual alarm provides persons with hearing loss the same warning delivered to hearing persons by an audible alarm.

Audible fire alarms have been a standard feature of building construction since the life safety codes of the early 1900s. However, visible signals did not appear even in accessibility codes until 1980. Early standards required relatively dim flashing lights at exit signs--an alarm system that was effective only along an exit route. As accessibility, life safety, and building codes were revised, however, they began to incorporate alarm technology that was developed for use in schools for persons who are deaf and in factories where ambient noise levels made audible alarms ineffective.

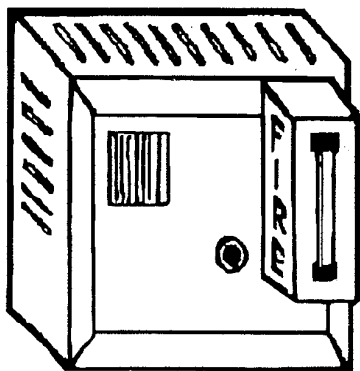
In passing the Americans with Disabilities Act in 1990, Congress specifically directed the Access Board to provide greater guidance regarding communications accessibility. Thus the *ADA Accessibility Guidelines (ADAAG)* require that where emergency warning systems are provided in new or altered construction, they must include both audible and visible alarms that meet certain technical specifications.

What are visual alarms?

Visual alarms are flashing lights used as fire alarm signals. The terms visual alarm signal, visible signal device, and visible signaling appliance are used relatively interchangeably within the fire protection community; the National Fire Protection Association (NFPA) calls them *visual notification appliances*. There is no practical distinction between a *visual* signal and a *visible* signal. Although visual signals may be used for other purposes, the type described in this Bulletin is appropriate only for use as an emergency alarm signal. An illustration shows a type of commercially-available alarm fixture that incorporates a visual alarm.

There are two major categories of fire alarms:

- *self-contained units*, as exemplified by the single-station residential smoke detector unit--battery-operated or hard-wired to building electrical



power--which produces an alarm signal at the fixture itself when activated by an integral sensing device, and

4.1.3 (14) New Construction.
If emergency warning systems are provided, then they shall include both audible and visual alarms complying with 4.28. Emergency warning systems in medical care facilities may be modified to suit standard health care alarm design practice.

4.28 Alarms.

4.28.1 General.

Alarm systems required to be accessible by 4.1 shall comply with 4.28. At a minimum, visual signal appliances shall be provided in buildings and facilities in each of the following areas: restrooms and any other general usage areas (e.g., meeting rooms), hallways, lobbies, and any other area for common use.

3.5 Definitions.

Common Use.

Refers to those interior and exterior rooms, spaces, or elements that are made available for the use of a restricted group of people (for example, occupants of a homeless shelter, the occupants of an office building, or the guests of such occupants).

4.1.1 Application.

(3)* Areas Used Only by Employees as Work Areas.

Areas that are used only as work areas shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the areas. These guidelines do not require that any areas used only

- *building-wide systems, integrated--often zoned--alarms whose local signals are remotely initiated, either automatically from detectors or manually from pull-stations spread throughout a facility.*

ADAAG requires that when either type is installed, it must have a visual alarm component.

Where are visual alarms required?

Facility design is subject to state and local ordinances that may both require and specify standards for emergency alarm systems. These regulations--building codes, life safety codes, accessibility codes, technical standards--are typically based upon national model codes and standards. The requirement for an emergency alarm system in new construction will be established by the applicable State or local building, life safety, or fire protection regulation. ADAAG does not mandate an emergency alarm system; its scoping provision at 4.1.3(14) simply requires that when emergency warning systems are provided, they shall include both audible and visual alarms that comply with 4.28.

Thus the requirement for an alarm system in a facility will trigger the ADAAG technical specifications for alarms. ADAAG 4.1.3(14) *Accessible Buildings: New Construction* requires that visual alarms be installed if emergency warning systems are provided in a new facility. In existing buildings, the upgrading or replacement of a fire alarm system also requires compliance--see ADAAG 4.1.6(b)--with ADAAG technical provisions for alarms.

Because it is not always possible to fix the occupancy of a room or space or anticipate its use by a person with a hearing impairment, visual alarms are required in every common use room or space in facilities equipped with an emergency alarm system. This is particularly important in those common use spaces where a person may be alone. ADAAG 4.28.1 *General* stipulates that alarm systems required to be accessible shall provide visible signals in restrooms, in other general and common use areas, and in hallways and lobbies. Common use areas also include meeting and conference rooms, classrooms, cafeterias, filing and photocopy rooms, employee break rooms, dressing, examination, and treatment rooms, and similar spaces that are not used solely as employee work areas.

System designers and specifiers must be particularly attentive to signal coverage issues. Where audible alarms are installed in corridors and lobbies to serve adjacent common use rooms, individual visual alarm signal appliances must be installed in those rooms, since the warning provided by a visual signal, unlike that of a bell or other annunciation system, can only be observed within the space in which it is installed. Dressing and fitting rooms, for example, can be easily protected by an audible alarm outside the room or space. However, the customer or patient who has a hearing impairment will not be alerted unless the dressing room he/she is using is protected with a visual alarm in (or above, if partitions do not extend to full height) the space. In general, it is not sufficient to install visual signals only at audible alarm locations.

Where are visual alarms not required?

ADAAG does not require that areas used only by employees as work areas be fully accessible. Thus, visual alarms are not required in individual employee offices and work stations. However, providing a visual alarm in the work area of an employee who is deaf or hard-of-hearing may be--like other elements of

as work areas be constructed to permit maneuvering within the work area or be constructed or equipped (i.e., with racks or shelves) to be accessible.

***For information on employee accommodation under title I of the ADA, contact the Equal Employment Opportunity Commission (EEOC) ADA information line at (800) 669-3362 (voice) or (800) 800-3302 (TTY).*

4.28.3 Visual Alarms.

Visual alarm signal appliances shall be integrated into the building or facility alarm system.

If single station audible alarms are provided then single station visual alarm signals shall also be provided. Visual alarm signals shall have the following minimum photometric and location features:

features:

(1)

The lamp shall be a xenon strobe type or equivalent.

(2)

The color shall be clear or nominal white (i.e., unfiltered or clear filtered white light).

(3)

The maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. The pulse duration is defined as the time between initial and final points of 10 percent of maximum signal.

(4)

The intensity shall be a minimum of 75 candela.

(5)

workplace accessibility-- a reasonable accommodation under title I** of the ADA, which addresses employment issues. The potential for such future employee accommodations should be considered when facility wiring is planned to facilitate a later connection to the building alarm system. Mechanical, electrical and telephone closets, janitor's closets, and similar non-occupiable spaces that are not common use areas nor assigned work areas are not required to have visual alarms.

What technical provisions apply to visual alarms?

The technical provisions of *ADAAG 4.28 Alarms* include minimum standards for the design and installation of single-station and building-wide visual alarm systems. They are based upon research sponsored by the Access Board and other groups, principally Underwriters Laboratories (UL).

To be effective, a visual signal--or its reflection from adjacent walls and ceiling--must be of an intensity that will raise the overall light level sharply, but not so intense as to be unsafe for direct viewing at a specified mounting height.

Technical criteria for visual alarm signal appliances are established in *ADAAG 4.28.3 Visual Alarms* (see sidebars).

In research sponsored by the Access Board, a high-intensity xenon strobe lamp was found to be the most effective in alerting persons with hearing impairments. White light was judged to be the most discernible; colored lamps (particularly red) were not effective even at extreme intensities.

Ninety percent of the research subjects were alerted by a 75 candela (cd) signal mounted fifty feet away on the wall directly behind them, where the horizontal output of a strobe lamp is measured at 100% of its nominal rating. For this reason, 75 cd is a minimum performance criterion--not a lamp sizing or specifying standard--for all locations within the 50-foot radius of the covered area. Because most strobes are not point sources, light output falls off sharply to the sides; a lamp with a maximum output of 75 cd when measured at 0 degrees will not provide the required increase in illumination at a 45 degree angle. Lamp intensity is given in effective candela, measured in use at the source.

Like a camera flash, the strobe produces a short burst of high-intensity light. The repetition of this pulse at a regular interval is the flash rate. Pulse duration--the interval of the flash between signal build-up and decay--is limited so that the signal is not temporarily blinding. Testing indicated that flash rate cycles between one and three Hertz (flashes per second) successfully alerted subjects with hearing impairments; a 3 Hz rate appeared to be somewhat more effective. Lamps tested at 1/3 Hz were adjudged ineffective. *ADAAG* thus requires flash rates within the 1 to 3 Hz range.

Rates that exceed 5 flashes per second may be disturbing to persons with photosensitivity, particularly those with certain forms of epilepsy. Information received during the development of *ADAAG* suggests that multiple unsynchronized visual signals within a single space may produce a composite flash rate that could trigger a photoconvulsive response in such persons (for example, two strobes set at 3 Hz in a room could generate a combined flash rate of 6 Hz). Installations that may produce a composite rate in excess of 5 Hz should therefore be avoided by decreasing the number of fixtures and raising the intensity of the lamps they contain, by decreasing the flash rate of multiple lamps, or by synchronizing the flash rates of multiple fixtures. This is particularly important in schools, since children are more frequently affected by photosensitivity than are adults.

The flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.

(6)

The appliance shall be placed 80 in (2030 mm) above the highest floor level within the space or 6 in (152 mm) below the ceiling, whichever is lower.

(7)

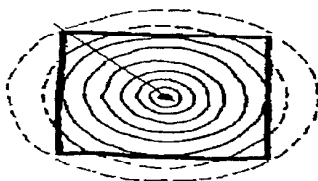
In general, no place in any room or space required to have a visual signal appliance shall be more than 50 ft (15 m) from the signal (in the horizontal plane).

In large rooms and spaces exceeding 100 ft (30 m) across, without obstructions 6 ft (2 m) above the floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft (30 m) apart, in lieu of suspending appliances from the ceiling.

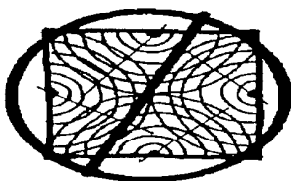
(8)

No place in common corridors or hallways in which visual alarm signaling appliances are required shall be more than 50 ft (15 m) from the signal.

Illustration 2
Strobe lamp coverage



Recommended



Not recommended

Mounting provisions were developed from NFPA signal criteria and UL smoke test findings. Strobes--whether projected from a wall or suspended from the ceiling--must be a minimum of 6 inches below the ceiling plane to avoid smoke obscuration in the event of a fire. To comply with provisions covering protruding objects, alarm devices must be at least 80 inches above the finished floor. To preclude installations that might be outside the field of view in high-ceilinged spaces such as atriums and warehouses, the guidelines require a strobe to be mounted at the lower of the two heights. However, photometric calculations of lamp intensity for mounting heights of 80 inches and of 96 inches show only nominal differences and can be practically considered to be equivalent. A single visual signal meeting ADAAG specifications could be expected to serve a large room or length of corridor if optimally located on perimeter walls or suspended below the ceiling so that the signal can spread throughout the space, unobstructed by furnishings, equipment, or room geometry.

In multipurpose facilities where bleacher seating, athletic equipment, backdrops, and other movable elements may at times be deployed or in warehouses, libraries, convention centers and other building types where devices would not be visible when installed at specified heights, optimal signal placement may require considerable study and the development of alternative intensity and placement calculations as an equivalent facilitation.

Provisions governing the spacing of visual alarms in hallways and corridors will generally require one fixture every 100 feet. In lengthy corridors, such as in shopping malls and large buildings, it is recommended that appliance spacing be maximized within the limits of the technical provision to minimize the effect of a composite flash rate on persons with photosensitivity. It is further recommended that the placement of visual signals along a corridor alternate between opposing walls to minimize the number of signals in a field of view.

What criteria affect the design of visual alarm systems?

Illustrations 2 through 4 describe general fixture placement and lamp coverage in schematic form. In general, it is recommended that visual alarm lamp intensity be maximized so as to require the minimum number of fixtures. Large, high-ceilinged spaces may best be served by suspended flash tubes of very high intensity (lamps up to 1000 candela are available for such applications). Smaller rooms, with an area that can be circumscribed by a circle 50 feet in radius, can be covered by a single, centrally located visual alarm meeting ADAAG intensity specifications. For very small rooms, such as examination, toilet, and dressing rooms, a single strobe of lesser intensity may well be sufficient as an equivalent facilitation.

When should equivalent facilitation be considered?

ADAAG technical provisions apply to normative conditions. Signal intensity and placement in very small and very large rooms and in spaces with high ceilings, irregular geometry, dark or non-reflective walls, or very high ambient lighting levels may best be determined by specialized consultants employing photometric calculation for system design rather than by a literal application of ADAAG specifications. For these reasons, ADAAG 2.2 *Equivalent Facilitation* permits alternative designs that achieve substantially equivalent or greater accessibility.

Lamp intensity (like sound) decreases in inverse relation to the square of its distance from the viewer. Thus, by varying lamp intensity and spacing, system designers can tailor an installation to the physical conditions of the space being served. It is impossible to provide specific guidance for the design of non-standard installations based upon the photometric calculations necessary to demonstrate equivalent facilitation. Such applications should generally be designed by

2.2 Equivalent Facilitation.

Departures from particular technical and scoping requirements of this guideline by the use of other designs and technologies are permitted where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the facility.

Illustration 3
Recommended spacing in corridors

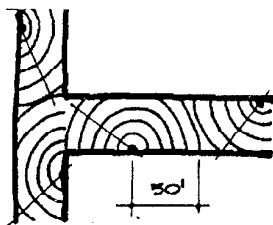
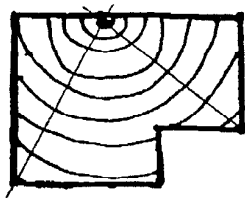


Illustration 4
Recommended placement in irregularly-configured room



4.28.4 Auxiliary Alarms.

Units and sleeping accommodations shall have a visual alarm connected to the building emergency alarm system or shall have a standard 110-volt electrical receptacle into which such an alarm can be connected and a means by which a signal from the building emergency alarm system can trigger such an auxiliary alarm. When visual alarms are in place the signal shall be visible in all

experienced electrical engineers or fire alarm consultants under performance specifications for coverage and illumination levels derived from the technical provisions of ADAAG 4.28 and ambient conditions in the space. For example, a 75 cd strobe at 50 feet raises the ambient light by 0.03 at 0 degrees in the horizontal plane. Equivalent design configurations should, therefore, result in approximately the same increase at all positions within the covered space.

As there is no process for certifying alternative methods (except in transportation facilities under DOT enforcement), the responsibility for demonstrating equivalent facilitation in the event of a challenge rests with the covered entity.

The American National Standard for Accessible and Usable Buildings and Facilities (CABO/ANSI A117.1-1992), reflecting current NFPA 72 performance recommendations for visual alarms, stipulates lamp, installation, and spacing criteria at some variance with ADAAG technical specifications for visual alarms and with this Bulletin. ANSI Table 4.26.3.2(a), Room Spacing Allocation, suggests that an alarm installation of several low-intensity lamps within a room is the practical equivalent of a single high-intensity lamp serving that space.

Given concerns for economy (lower-candela lamps are less expensive to purchase and connect) and lamp standardization within a building (lower-candela lamps are more available and simplify inventorying), specifiers may be motivated to standardize on a minimum-candela fixture, achieving coverage in large rooms by close spacing of low-intensity lamps. The Access Board strongly discourages this practice. Where a single lamp can provide the necessary intensity and coverage, multiple lamps should not be installed because of their potential effect on persons with photosensitivity.

What types of visual alarms are available?

Most major suppliers to the fire protection industry manufacture visual appliances, which are readily available to electrical contractors and others responsible for the installation of building alarm systems. Visual alarms incorporating smoke detectors and lamp-only signal appliances are supplied through standard sources, although some lamp intensities and visual alarm fixtures may not be commonly stocked. Strobe lamps are commercially available in varying intensities up to 200 candela. Higher intensities can be provided by specialized manufacture.

Although an integrated audible and visual signal is available at about the same cost as an audible or visual signal alone, more visual signals than audible signals will be necessary for most applications. Careful attention to reflection from surfaces can increase light dispersion and coverage in both new and renovated structures.

What visual alarm requirements apply to sleeping rooms in transient lodging facilities?

ADAAG 9.3.1 requires that sleeping units covered by Section 9 Accessible Transient Lodging have a visual alarm connected to the building alarm system or provide a power outlet for a portable device that can be triggered by the building emergency alarm system (such units can be activated by a signal from the central alarm control system, transmitted through the standard 110V building wiring to a receiver plugged into a power outlet at a remote location). Portable units with a standard 110 volt electrical cord are available from specialized retailers of products for persons who are deaf and hard-of-hearing. Because guest room sizes are not large in such occupancies, the technical specification of 4.28.4 Auxiliary Alarms requires only that the signal--intended to alert persons who are awake--be visible in all areas of the room or unit.

*areas of the unit or room.
Instructions for use of the
auxiliary alarm or receptacle
shall be provided.*

9.3 Visual Alarms, Notification Devices and Telephones.

9.3.1 General.

*In sleeping rooms required to
comply with this section,
auxiliary visual alarms shall be
provided and shall comply with
4.28.4. Visual notification
devices shall also be provided in
units, sleeping rooms and suites
to alert room occupants of
incoming telephone calls and a
door knock or bell. Notification
devices shall not be connected
to auxiliary visual alarm signal
appliances
[...].*

9.3.2 Equivalent Facilitation.

*For purposes of this section,
equivalent facilitation shall
include the installation of
electrical outlets (including
outlets connected to a facility's
central alarm system) and
telephone wiring in sleeping
rooms and suites to enable
persons with hearing
impairments to utilize portable
visual alarms and
communication devices provided
by the operator of the facility.*

**The technical assistance
provided in this Bulletin is
intended solely as informal
guidance; it is not a
determination of the legal
rights or responsibilities of
entities subject to titles II or III
of the ADA.**

Visual alarms are not the technology of choice for awakening sleeping persons, however. A UL study concluded that a flashing light more than seven times brighter than that needed to alert office workers would be required to arouse a person who was asleep (110 cd vs. 15 cd at 20 feet, if mounted 24 inches or more from the ceiling; 177 cd if mounted less than 24 inches from the ceiling, where smoke obscuration might be a significant factor). Alarm system designers are advised to consider the UL findings if visual alarms are to be employed to warn sleeping persons of emergencies.

Although ADAAG does not establish standards for portable items or auxiliary aids, assistive devices may be required by section 36.303 of the Department of Justice title III final rule. However, technologies other than visual signalling may offer equivalent or superior warning for sleeping guests who have hearing impairments. For example, a signal-activated vibrator was found to be much more effective in alerting sleepers than were the visual signals tested in the UL research. Such devices are commonly available and may be connected to or activated by a building alarm system. Care must be taken that notification devices intended to signal a door knock or bell are separately wired.

Why is there an exception in the scoping requirements of 4.1.3(14) for "standard health care alarm design practice"?

In medical care settings where a supervised emergency evacuation plan is in place, it is usually not desirable to install alarms in patient rooms or wards. In such occupancies, personnel responsible for ensuring the safe egress of patients will respond to an intercom message or other signal that is not intended to alert or alarm patients incapable of independent evacuation. Additionally, visual alarms may not be appropriate for use in some specialized medical facilities, such as operating rooms, where lighting levels are high and the sudden discharge of a strobe flash might adversely affect a surgical procedure. For such facilities, the requirements for visual and audible alarms may be modified to suit industry-accepted practices.

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